G36 Nucleic Acid Degradation and the Postmortem Interval

Arpad A. Vass, PhD, Oak Ridge National laboratory, PO Box 2008 MS6120, 1 Bethel Valley Road, Oak Ridge, TN 37831-6120; Rachel I. Fleming, PhD, and SallyAnn Harbinson, PhD, Institute of Environmental Science and Research, Private Bag 92-021, Auckland, NEW ZEALAND; James M. Curran, PhD, The University of Auckland, Department of Statistics, Private Bag 92-019, Auckland, NEW ZEALAND; and Eletra Williams, MS, University of Auckland, Department of Chemistry, Private Bag 92-019, Auckland, NEW ZEALAND*

After attending this presentation, attendees will be updated on how to capitalize on the utilization of modern molecular biology techniques, providing new and powerful statistically based tools uniting forensic biology and forensic pathology together with the potential to reveal crucial information regarding the circumstances surrounding a potential crime.

This presentation will impact the forensic science community by providing understanding of how the analysis of DNA and RNA from aged and/or degraded samples may reveal vital information about processes involved in decomposition, as these also affect nucleic acids. This has the potential to be of benefit in the analysis of samples that may traditionally be compromised and difficult to analyze.

While DNA has been used for over twenty years in forensic biology the potential applications for RNA have only recently received attention after the revelation that RNA is more stable than previously thought. By studying DNA and RNA from aged and/or degraded samples we expect to learn more about the processes involved in decomposition, as these also affect nucleic acids. This has the potential to be of benefit in the analysis of samples that may traditionally be compromised and difficult to analyze.

This study measured the systematic rate of decay of nucleic acids (DNA and RNA) in hard tissues such as nails, teeth, and bone. These tissues are more stable against environmental conditions due to the inherent biochemical structure of the tissue. The rate of degradation of nucleic acids in these tissues will be less influenced by external environmental factors and utilization of the rate of nucleic acid degradation found is likely to lead to the development of postmortem interval indicators for longer time periods. A unique aspect of this research is the ability to take multiple samples from various human cadaver tissues at different time intervals without interfering with the decompositional process. This methodology, incorporating various time intervals, has not been studied before in relation to the degradation of nucleic acids in a systematic manner using human cadavers.

A critical aspect of assessing nucleic acid degradation was the recovery of RNA and DNA without any further fragmentation. Previously studies have shown that the DNA isolation and quantitation extraction system can be successfully adapted to allow the co-extraction of RNA and DNA without compromising the quality of either nucleic acid. An important practical aspect of this work is the further adaptation of this method to co-extract RNA and DNA from bone and nail samples. This will ease implementation into forensic laboratories as many already have the necessary skills and capacity to perform this adapted extraction strategy.

This initial research has identified the most useful genetic markers and established the experimental system required for analyses to assess whether ribs, nails or teeth are preferred as tissues for PMI estimation using this technique.

It was found that nails contain relatively high levels of DNA and RNA. Using reverse transcriptase PCR (RT-PCR), we have amplified four keratin mRNA transcripts and 18S rRNA from nail samples. After placement of nail samples in different environments, including submerged in water, soil, and at room temperature we have found that all four keratin mRNA transcripts are stable under different environmental conditions for significantly long time periods. Using these results, a statistical model has been developed to correlate the rate of degradation of the different keratin mRNA transcripts and 18S rRNA with the time since the material was sampled (PMI). Using nails collected from cadavers, we have applied the statistical model to determine the PMI in real-life situations. This work has shown that DNA and RNA in nails are stable and suitable for use in estimating the PMI.

DNA, RNA, Postmortem interval

 ** Presenting Author*